Technical Description

SMA CLUSTER CONTROLLER Modbus® Interface

ClusterController_Modbus-TB-US-en-15 | Version 1.5

ENGLISH

Legal Provisions

Copyright © 2012-2014 SMA America, LLC. All rights reserved.

No part of this document may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photographic, magnetic or otherwise, without the prior written permission of SMA America, LLC.

Neither SMA America, LLC nor SMA Solar Technology Canada Inc. makes representations, express or implied, with respect to this documentation or any of the equipment and/or software it may describe, including (with no limitation) any implied warranties of utility, merchantability, or fitness for any particular purpose. All such warranties are expressly disclaimed. Neither SMA America, LLC nor its distributors or dealers nor SMA Solar Technology Canada Inc. nor its distributors or dealers shall be liable for any indirect, incidental, or consequential damages under any circumstances.

(The exclusion of implied warranties may not apply in all cases under some statutes, and thus the above exclusion may not apply.)

Specifications are subject to change without notice. Every attempt has been made to make this document complete, accurate and up-to-date. Readers are cautioned, however, that SMA America, LLC and SMA Solar Technology Canada Inc. reserve the right to make changes without notice and shall not be responsible for any damages, including indirect, incidental or consequential damages, caused by reliance on the material presented, including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the content material.

All trademarks are recognized even if these are not marked separately. Missing designations do not mean that a product or brand is not a registered trademark.

The *Bluetooth*® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by SMA America, LLC and SMA Solar Technology Canada Inc. is under license.

Modbus® is a registered trademark of Schneider Electric and is licensed by the Modbus Organization, Inc.

SMA America, LLC

3801 N. Havana Street

Denver, CO 80239 U.S.A.

SMA Solar Technology Canada Inc.

2425 Matheson Blvd. E, 7th Floor

Mississauga, ON L4W 5K4, Canada

Important Safety Instructions

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the following products:

- SMA Cluster Controller

This manual must be followed during installation and maintenance.

The product is designed and tested in accordance with international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing and/or operating the product. To reduce the risk of personal injury and to ensure the safe installation and operation of the product, you must carefully read and follow all instructions, cautions and warnings in this manual.

Warnings in this document

A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the SMA equipment and/or other equipment connected to the SMA equipment or personal injury.

Symbol	Description
⚠ DANGER	DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury
⚠ CAUTION	CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE	NOTICE Indicates a situation which, if not avoided, could result in property damage

Table of Contents

1 Information on this Document 6

2 Safety 9

2.1 Intended Use 9
2.2 Skills of Qualified Persons 9
2.3 Safety Precautions 9
2.4 Information on Data Security 10

3 Product Description 11

3.1 Modbus Protocol 11
3.2 SMA Modbus Profile 11
3.3 User-Defined Modbus Profile 11
3.4 PV System Topology 11
3.5 Addressing and Data Transmission in the Modbus Protocol 14
3.5.1 Unit IDs 14
3.5.2 Assignment of the Modbus Register to Unit IDs 14
3.5.3 Modbus Register Address, Register Width and Data Block 15
3.5.4 Address Range for Modbus Register 15
3.5.5 Data Transmission 15
3.6 Reading and Writing of Data 15
3.7 SMA Data Types 17
3.7.1 SMA Data Types and NaN Values 17
3.7.2 16-Bit Integer Values 17
3.7.3 32-Bit Integer Values 17
3.7.4 64-Bit Integer Values 18
3.8 SMA Data Formats 18

4 Commissioning and Configuration 20

4.1 Commissioning Steps and Requirements 20
4.2 Information on Changing Unit IDs 20
4.3 Changing Unit IDs via the Gateway 21
4.3.1 Reading out the Gateway 21
4.3.2 Changing a Unit ID in the Gateway 22
4.4 Changing Unit IDs via the XML File usrplant.xml 23
4.4.1 Overview 23
4.4.2 Structure of the XML File usrplant.xml 23
4.4.3 Activating and Deactivating usrplant.xml 24

4.5 Resetting the Cluster Controller to the Default Settings 25

5 SMA Modbus Profile – Assignment Tables 26

5.1 Information on the Assignment Tables 26
5.2 Gateway (Unit ID = 1) 27
5.3 PV System Parameters (Unit ID = 2) 29
5.4 SMA Devices (Unit ID = 3 to 247) 31

6 User-Defined Modbus Profile 52

6.1 Structure of the XML File for the User-Defined Modbus Profile 52
6.2 Example of a User-Defined Modbus Profile 53
6.3 Activating and Deactivating User-Defined Modbus Profile 54

7 Troubleshooting 55

8 Technical Data 56

8.1 Supported SMA Inverters 56
8.2 Number of SMA Devices 56
8.3 Modbus Communication Ports 56
8.4 Data Processing and Time Behavior 57
8.5 Number Codes of the Time Zones 58
8.6 Frequently Used Number Codes (ENUM) 60

9 Contact 61

10 Index 62

1 Information on this Document

Validity

This document is applicable for device type "CLCON-10" and device type "CLCON-S-10"* (SMA Cluster Controller). It describes the Modbus interface of the SMA Cluster Controller, the variant of the "Modbus® Application Protocol" implemented by SMA, and the corresponding parameters, measured values and data exchange formats.

* Not available in all countries (see the SMA Cluster Controller product page at www.SMA-Solar.com)

This document does not contain any details on the parameters and measured values provided by SMA devices (for operating parameters/measured values, see the Technical Description "Measured Values and Parameters" at www.SMA-Solar.com).

This document does not contain any information on software which can communicate with the Modbus interface (see the software manufacturer's manual).

Target Group

This document is intended for qualified persons. Only persons with appropriate skills are allowed to perform the tasks described in this document (see Section 2.2 "Skills of Qualified Persons).

Additional Information

SMA Documents

Additional information is available at www.SMA-Solar.com:

Document title	Document type
SMA Cluster Controller	Installation Manual
SMA Cluster Controller	User Manual
Measured Values and Parameters	Technical Description

Additional Documents

Document title	Source
Modbus Application Protocol Specification	http://www.modbus.org/specs.php
Service Name and Transport Protocol Port Number Registry	http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml

Symbols

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal

Typographies

Typography	Use	Example
bold	• Elements to be selected • Elements on a user interface • File names • Parameters	• Select **Settings**. • Control via **communication**. • The file **usrprofile.xml** • The values **Major** and **Minor**

Nomenclature

Complete designation	Designation in this document
Modbus register	Register
Photovoltaic system	PV system
SMA Cluster Controller	Cluster Controller

Abbreviations

Abbreviation	Designation	Explanation
GFDI	Ground-Fault Detection and Interruption	Detection of the grounding error and subsequent interruption of the electric circuit.
PMAX	Set active power limit	The device can generate active power up to this limit.
Power Balancer	-	The Power Balancer is a function in Sunny Mini Central devices for controlling three-phase grid feed-in, for example, to avoid unbalanced loads.

SMA fieldbus	-	Hardware interface for communication between SMA devices (e.g. Speedwire). For information on the supported communication interfaces, refer to the datasheet of the SMA device being used.
SUSy-ID	SMA Update System-ID	Numeric value that identifies a specific SMA device type, e.g. 128 = STP nn000TL-10.

2 Safety

2.1 Intended Use

The Modbus interface of the SMA Cluster Controller is designed for industrial use and has the following tasks:

- Remote control of the grid management services of a PV system
- Remote-controlled querying of the measured values of a PV system
- Remote-controlled changing of the parameters of a PV system.

The Modbus interface can be used via the protocol Modbus TCP and by the protocol Modbus UDP.

The enclosed documentation is an integral part of this product.

- Read and observe the documentation.
- Keep the documentation in a convenient place for future reference.

2.2 Skills of Qualified Persons

The tasks described in this document must be performed by qualified persons only. Qualified persons must have the following skills:

- Knowledge of IP-based network protocols
- Training in the installation and configuration of IT systems
- Knowledge of and compliance with this document and all safety precautions

2.3 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the product. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and follow all safety precautions at all times.

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Contact the SMA Service Line if you would like to automate the remote control of your PV system (see Section 9 "Contact", page 61).

2.4 Information on Data Security

Data security in Ethernet networks

You can connect the Cluster Controller to the Internet. When connecting to the Internet, there is a risk that unauthorized users can access and manipulate the data of your PV system.

- Take appropriate protective measures, e.g.
  - Set up a firewall.
  - Close unnecessary network ports.
  - Only enable remote access via VPN tunnel.
  - Do not set up port forwarding at the Modbus port in use.

3 Product Description

3.1 Modbus Protocol

The Modbus Application Protocol is an industrial communication protocol that is currently used in the solar sector mainly for plant communication in PV power plants.

The Modbus protocol has been developed for reading data from or writing data to clearly defined data areas. The Modbus specification does not prescribe what data is within which data area. The data areas must be defined device-specifically in Modbus profiles. With knowledge of the device-specific Modbus profile, a Modbus master (e.g. SCADA system) can access the data of a Modbus slave (e.g. SMA Cluster Controller).

The special Modbus profile for SMA devices is the SMA Modbus profile.

3.2 SMA Modbus Profile

The SMA Modbus profile contains definitions for SMA devices. A reduction of the available data on SMA devices was carried out for the definition and this was then assigned to the corresponding Modbus registers. The SMA Modbus profile contains, for example, the total and daily energy, current power, voltage and current levels. The assignment between SMA device data and Modbus addresses is split into ranges in the SMA Modbus profile and these can be addressed via unit IDs (see Section 3.5 " Addressing and Data Transmission in the Modbus Protocol ", page 14).

To enable access to data of an SMA device, a special gateway is required and this is provided by way of the Cluster Controller.

3.3 User-Defined Modbus Profile

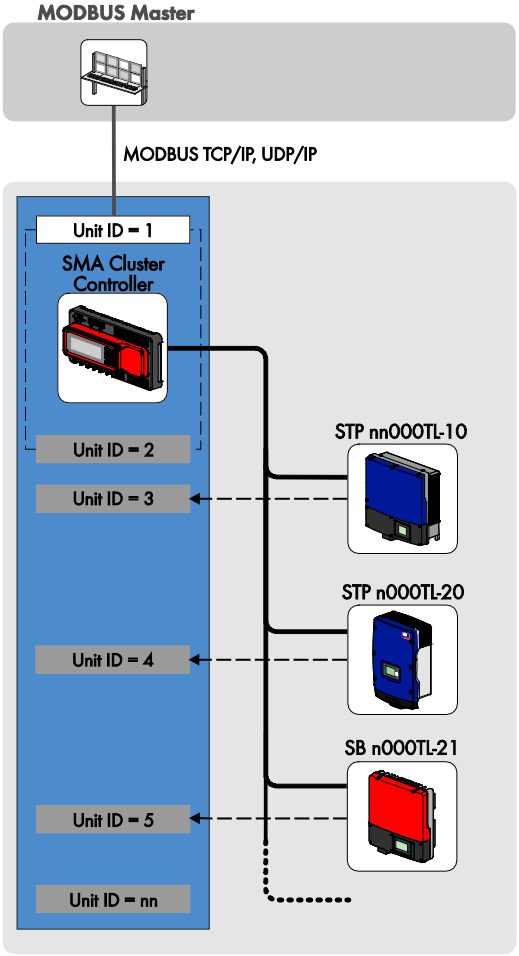
The user-defined Modbus profile enables you to reassign Modbus addresses of the SMA Modbus profile. One advantage of reassigning Modbus addresses is, for example, that you can arrange relevant measured values and parameters in sequence for a specific purpose. These addresses can then be read and written in a single data block.

3.4 PV System Topology

The SMA Modbus profile was developed for a hierarchical PV system structure. In this structure, the Cluster Controller is a communication device which is equipped with a Modbus TCP/IP and Modbus UDP/IP interface. All additional SMA devices that are connected to the Cluster Controller via the SMA fieldbus are subordinate to the Cluster Controller.

From the perspective of the Modbus protocol, the Cluster Controller represents a Modbus slave that provides a gateway to SMA devices. The SMA devices can only be addressed using this gateway per unit ID.

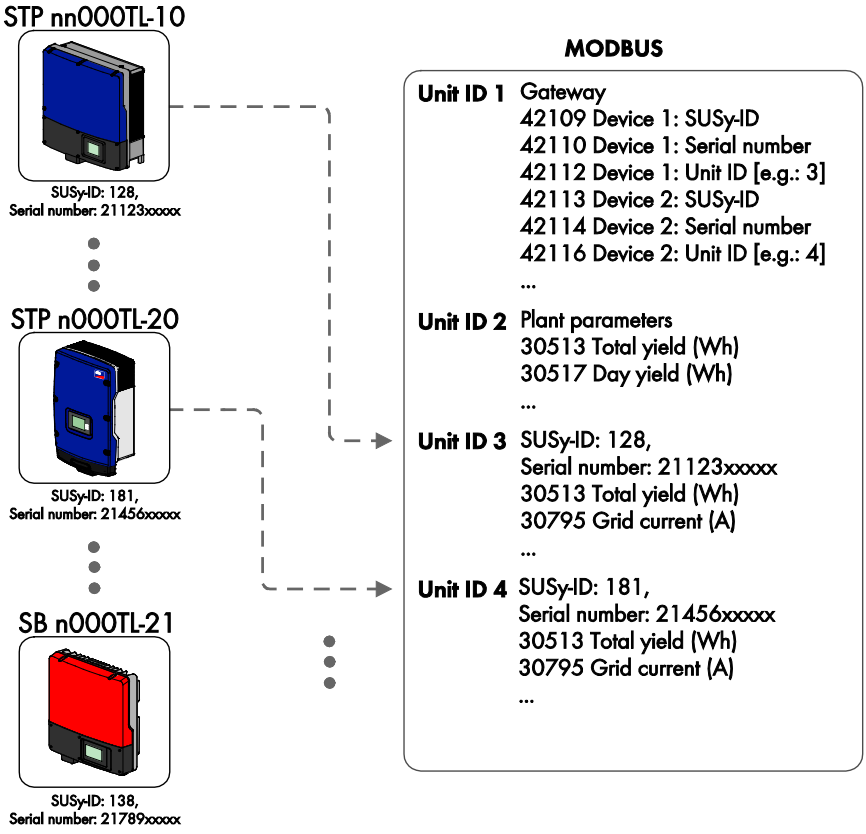
Example 1: PV System Topology from the Perspective of the SMA Devices



Line	Explanation
———	IP network connection between SCADA system and Cluster Controller (PV system router)
———	SMA fieldbus
– – –	Logical assignment of SMA device to unit ID

Example 2: PV System Topology from the Perspective of the Modbus Protocol

In the following example, an inverter is assigned to a unit ID between 3 and 247 in each case. This way the inverter data can be addressed in the Modbus protocol. Unit ID 1 represents the gateway to the Modbus protocol and unit ID 2, the PV system parameters.



3.5 Addressing and Data Transmission in the Modbus Protocol

3.5.1 Unit IDs

The unit ID is a higher level addressing type in the Modbus protocol. The SMA Modbus protocol has 247 unit IDs, of which, 245 can be assigned to individual devices. If a unit ID is assigned to a device, then the parameters and measured values of this device can be accessed.

The following table shows an overview of the unit IDs in the SMA Modbus profile:

Unit ID	Explanation
1	This unit ID is reserved for the gateway of the Cluster Controller.
2	This unit ID is reserved for the PV system parameters.
3 to 247	The unit IDs 3 to 247 are used for addressing individual devices and for the user-defined Modbus profile. You can change the assignment of these unit IDs (see Section 4.2 "Information on Changing Unit IDs", 20).
255	Devices which are assigned to this unit ID, were connected to the Cluster Controller or replaced after activation of the Modbus server. The devices cannot be addressed with this unit ID. You must assign unit IDs from the range 3 to 247 to these devices (see Section 4.2 "Information on Changing Unit IDs", page 20).

3.5.2 Assignment of the Modbus Register to Unit IDs

The assignment of the parameters and measured values of the SMA devices to Modbus register addresses is achieved using assignment tables and is also shown in this document (see Section 5 "SMA Modbus Profile – Assignment Tables", page 26).

In the assignment table "Gateway (unit ID = 1)", the assignment of SMA devices to individual unit IDs is saved in the Modbus registers from address 42109 . Each assignment has an address range of four Modbus registers, although only the corresponding register is writable with the unit ID.

In the assignment table "PV System Parameters (unit ID = 2)", parameters and measured values of the Cluster Controller and the PV system are stored.

In the assignment table "SMA devices (unit ID = 3 to 247)", the parameters and measured values intended for all SMA devices are stored. The individual SMA devices use a subset of these for their device-specific parameters and measured values.

3.5.3 Modbus Register Address, Register Width and Data Block

A Modbus register is 16 bits wide. For broader data items, connected Modbus registers are used and considered as data blocks. The number of connected Modbus registers is indicated in the assignment tables. The address of the first Modbus register in a data block is the start address of the data block.

3.5.4 Address Range for Modbus Register

For addressing Modbus registers, the address range 0 to 0xFFFF is available with 65536 addresses.

3.5.5 Data Transmission

In accordance with the Modbus specification, only a specific volume of data can be transported in a single transmission in a simple protocol data unit (PDU). The data also contains function-dependent parameters, such as the function code, start address or number of Modbus registers to be transmitted. The amount of data depends on the Modbus command used and has to be taken into account during data transmission. You can find the number of possible Modbus registers per command in Section 3.6.

With data storage in the Motorola format "big-endian", data transmission begins with the high byte and then the low byte of the Modbus register.

3.6 Reading and Writing of Data

The Modbus interface can be used via the protocol Modbus TCP and via the protocol Modbus UDP. Using Modbus TCP enables read and write access (RW) and using Modbus UDP enables only write access (WO) to the Modbus register.

The following Modbus commands are supported by the implemented Modbus interface:

Modbus command	Hexadecimal value	Data volume (number of registers)[1]
Read Holding Registers	0x03	1 to 125
Read Input Registers	0x04	1 to 125
Write Single Register	0x06	1

[1] Number of Modbus registers transferable as data block per command

Write Multiple Registers	0x10	1 to 123
Read Write Multiple Registers	0x17	Read: 1 to 125, Write: 1 to 121

Error messages on reading or writing individual Modbus registers

If a Modbus register is accessed, which is not contained in a Modbus profile, or if a Modbus command is incorrect, a Modbus exception is generated. Modbus exceptions are also generated when write access occurs on a read-only Modbus register or read access occurs on a write-only Modbus register.

Reading or writing of data blocks

To prevent inconsistencies, data blocks of associated registers or register ranges must be read or written in a single step. The 4 bytes of a 64-bit Modbus register must, for example, be read with an operation in a 64-bit SMA data type.

Error message on writing multiple Modbus registers as a data block

If multiple registers are written as a data block (Modbus commands 0x10 and 0x17) and an error occurs during writing, the faulty register as well as all the subsequent registers in the packet will be rejected. In the event of an error a Modbus exception will be generated.

Modbus exceptions

Modbus exceptions, see "Modbus Application Protocol Specification" at http://www.modbus.org/specs.php.

3.7 SMA Data Types

3.7.1 SMA Data Types and NaN Values

The following table shows the data types used in the SMA Modbus profile and shows possible NaN values. The SMA data types are listed in the **Type** column of the assignment tables. They describe the data widths of the assigned values:

Type	Description	NaN value
U16	A word (16-bit/WORD)	0xFFFF or -1
S16	A signed word (16-bit/WORD)	0x8000
U32	A double word (32-bit/DWORD)	0xFFFF FFFF or -1
U32	For status values, only the lower 24 bits of a double word (32-bit/DWORD) are used.	0xFFFF FD or 0xFFFF FE or -1
S32	A signed double word (32-bit/DWORD)	0x8000 0000
U64	A quad word (64-bit/2 x DWORD)	0xFFFF FFFF FFFF FFFF or -1

3.7.2 16-Bit Integer Values

16-bit integers are stored in a Modbus register.

Modbus register	1	
Byte	0	1
Bits	8 to 15	0 to 7

3.7.3 32-Bit Integer Values

32-bit integers are stored in two Modbus registers.

Modbus register	1		2	
Byte	0	1	2	3
Bits	24 to 31	16 to 23	8 to 15	0 to 7

3.7.4 64-Bit Integer Values

64-bit integers are stored in four Modbus registers.

Modbus register	**1**		**2**	
Byte	0	1	2	3
Bits	56 to 63	48 to 55	40 to 47	32 to 39
Modbus register	**3**		**4**	
Byte	4	5	6	7
Bits	24 to 31	16 to 23	8 to 15	0 to 7

3.8 SMA Data Formats

The following SMA data formats describe how SMA data is to be interpreted. The data formats are important, for example, for the display of data or for its further processing. The SMA data formats are listed in the **Format** column of the assignment tables.

Format	Explanation
DT	**Date/Time** Date/time, in accordance with country setting. Transmission as UTC (seconds since 1970-01-01).
Duration	**Duration** Time in seconds, in minutes or in hours, depending on the Modbus register
ENUM	Coded numerical values The breakdown of the possible codes can be found directly under the designation of the Modbus register in the SMA Modbus profile – assignment tables (see also Section 8.6 "Frequently Used Number Codes", page 60).
FIX0	**Factor 1** Decimal number, commercially rounded, no decimal place
FIX1	**Factor 0.1** Decimal number, commercially rounded, one decimal place
FIX2	**Factor 0.01** Decimal number, commercially rounded, two decimal places

FIX3	**Factor 0.001** Decimal number, commercially rounded, three decimal places
FW	Firmware version (see "Firmware version extract" below)
RAW	Text or number. A RAW number has no decimal places and no thousand or other separation indicators.
TEMP	**Temperature** Temperature values are stored in special Modbus registers in degrees Celsius °C, in degrees Fahrenheit °F, or in Kelvin K. The values are commercially rounded, with one decimal place.

Firmware version extract, format "FW": From the delivered DWORD, four values are extracted. The **Major** and **Minor** values are contained BCD-coded in bytes 1 and 2. Byte 3 contains the **Build** value (not BCD-coded). Byte 4 contains the **Release Type** value according to the following table:

Release type	Release-type coding	Explanation
0	N	No revision number
1	E	Experimental release
2	A	Alpha release
3	B	Beta release
4	R	Release
5	S	Special release
> 5	As number	No special interpretation

Example:

Firmware version of the product: 1.5.10.R
Values from DWORD: Major: 1, Minor: 5, Build: 10, Release type: 4
(Hex: 0x1 0x5 0xA 0x4)

4 Commissioning and Configuration

4.1 Commissioning Steps and Requirements

Requirements:

☐ The devices of the PV system must be connected to the Cluster Controller and the Cluster Controller must be commissioned (for information on connection and commissioning, see the Cluster Controller installation manual).

☐ You must log in as installer to the Cluster Controller (for login to or logout of the Cluster Controller, see the Cluster Controller user manual).

Procedure:

1. Activate the Modbus server(s) and, if required, configure the communication ports (for Modbus configuration, see the Cluster Controller user manual).

Allocation of unit IDs by activation of the Modbus servers

Upon activation of the Modbus servers of the Cluster Controller, unit IDs are assigned to the SMA devices already connected to the Cluster Controller. The protocol types TCP/UDP can be activated individually or together. If one or both of the servers are deactivated and reactivated, the previously assigned Modbus unit IDs remain intact.

2. Change the unit IDs if, after activation of the Modbus servers, further SMA devices have been added to the PV system or SMA devices have been replaced (see the following sections).

4.2 Information on Changing Unit IDs

You can change the unit IDs of SMA devices. A change is required, for example, if additional or changed SMA devices are connected to the Cluster Controller after activation of the Modbus servers. By way of the automatic detection of the PV system, additional or changed devices are assigned the Modbus unit ID = 255 (NaN). On the other hand, it may be necessary to change the unit IDs if a restructuring of the system topology is required, for example, to better map the physical arrangement of the devices in the Modbus protocol.

Depending on whether you wish to change individual unit IDs or restructure the entire system topology, you have two options:

- Changing Unit IDs via the gateway (recommended for changing individual Unit IDs)
- Changing Unit IDs via an XML file (recommended for restructuring of the system topology)

Both of these methods are described in separate Sections.

4.3 Changing Unit IDs via the Gateway

4.3.1 Reading out the Gateway

You can read out the individual unit IDs of the SMA devices from the gateway, for example, using a SCADA system.

Accessing the gateway

You access the gateway via the IP address of the Cluster Controller, under the unit ID = 1.

The assignment of the system devices for unit IDs 3 to 247 is stored in the Modbus registers from address 42109. Each assignment has an address range of four Modbus registers. You can find the Modbus register of the gateway in Section 5.2 "Gateway", page 27.

Example "Read out additional device from the gateway"

Via automatic detection, an additional SMA device was assigned to unit ID = 255 (indicated with C in column "Device #" in the following table). The assignments of the gateway were, as follows here, shown with a SCADA system as a table:

Modbus address	Content	Description	Device #
...	...	...	
42109	*158*	*SUSy ID*	A
42110	*2145600972*	*Serial number*	A
42112	*3*	*Unit ID*	A
42113	*158*	*SUSy ID*	B
42114	*2145600320*	*Serial number*	B
42116	*4*	*Unit ID*	B
42117	*158*	*SUSy ID*	C
42118	*2145600934*	*Serial number*	C
42120	*255*	*Unit ID*	C
...	...	...	...

4.3.2 Changing a Unit ID in the Gateway

You change a unit ID by writing it to the relevant Modbus address. All three of the Modbus registers that belong to a device-unit-ID assignment must be transmitted in a single data block, although only the register with the unit ID is writable. For the following example, this means that all the data of the three Modbus addresses 42117, 42118 and 42120 must be contained in the data block.

Do not assign unit IDs more than once

You must not assign a Unit ID more than once. In the event of a Modbus query with a unit ID that has been assigned more than once, the data is read out for the device that is entered with this unit ID in the gateway under the lowest Modbus address.

Example "Changing A Unit ID in the Gateway"

The following table shows an example of assignment of a device to a unit ID. An inverter was subsequently detected with SUSy ID = 158 and serial number 2145600934, as the third device in the PV system (Modbus addresses 42117 to 42120). The unit ID of this device was manually set to 5:

Modbus address	Designation	After detection	Modified
42117	SUSy ID	158	158
42118	Serial number	2145600934	2145600934
42120	Unit ID	255 (NaN)	5

4.4 Changing Unit IDs via the XML File usrplant.xml

4.4.1 Overview

The Cluster Controller stores the assignments of the devices of the PV system to unit IDs in the file **sysplant.xml**. This file contains an excerpt of the gateway (see Section 5.2 "Gateway (Unit ID = 1)", page 27). If new SMA devices are added or if SMA devices are replaced, these are respectively added to the available XML structure of this file with unit ID = 255 by the Cluster Controller. You can define your own variant of this file in the file **usrplant.xml**. You can use **sysplant.xml** as a template for **usrplant.xml**.

You can download the file **sysplant.xml** from the Cluster Controller.

Uploading and downloading XML files

For more information on uploading and downloading XML files via the user interface, see the SMA Cluster Controller user manual.

The file **usrplant.xml** must be activated in the Cluster Controller. Once the file **usrplant.xml** is activated, the file **sysplant.xml** is not taken into consideration for the duration of the activation.

4.4.2 Structure of the XML File usrplant.xml

The files **sysplant.xml** and **usrplant.xml** have the same tag structure.

The basic structure of the files is as follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<plant version="001">
        <device regoffs="aaa" susyid="bbb" serial="ccccccccc" unitid="ddd" />
        ...
</plant>
```

Legend for XML tags and attributes:

XML tag or attribute	Explanation
<device.../>	Within the tag "Device" is the assignment of a device to a unit ID.
regoffs="aaa"	Number of the device in file sysplant.xml. The number must not necessarily be assigned sequentially. There are four decimal Modbus register addresses between the devices. Regoffs = 0 defines the first device under the Modbus address 42109, Regoffs = 244 the last device under the Modbus address 43085.
susyid="bbb"	SUSy ID of the device

serial="ccccccccc"	Serial number of the device
unitid="ddd"	Unit ID of the device

Example of the file usrplant.xml

The unit IDs of the following two SMA devices are to be changed to unit ID 3 and 4:

- SB 5000 TL-21, SUSy ID = 138, Serial number = 2178909920, current position in gateway = 7
- STP 15000TL-10, SUSy ID = 128, Serial number = 2112303920, current position in gateway = 8

The exact appearance of the XML file is then as follows:

<?xml version="1.0" encoding="UTF-8"?>

<plant version="001">

<device regoffs="7" susyid="138" serial="2178909920" unitid="3" />

<device regoffs="8" susyid="128" serial="2112303920" unitid="4" />

</plant>

4.4.3 Activating and Deactivating usrplant.xml

Activating the file usrplant.xml:

To activate the file **usrplant.xml**, upload the file to the Cluster Controller. All the specifications in the file are checked. If the file contains no errors, its contents are entered into the system. A changed **usrplant.xml** becomes effective a few seconds after it is activated. Once the file **usrplant.xml** is activated, the file **sysplant.xml** is not taken into consideration for the duration of the activation.

Deactivating the file usrplant.xml:

To deactivate the file **usrplant.xml**, upload a version of this file containing no device tags to the Cluster Controller. Both of the following lines show the structure of such a **usrplant.xml** file:

<?xml version="1.0" encoding="UTF-8"?>

<plant version="001"></plant>

Without the device tags in the file **usrplant.xml**, the system returns to the specifications saved in the file **sysplant.xml**. A changed **usrplant.xml** becomes effective a few seconds after it is saved to the Cluster Controller.

4.5 Resetting the Cluster Controller to the Default Settings

By resetting the Cluster Controller to the default settings, the previously assigned unit IDs are deleted and reassigned – file **sysplant.xml** is therefore rewritten. As a result, all connected SMA devices are assigned a new unit ID.

Save data prior to restoring default settings

By resetting the Cluster Controller to default settings, the user-defined PV system topology **usrplant.xml** and the user-defined Modbus profile **usrprofile.xml** are deleted. Save these files before resetting.

For further information on resetting to default settings and saving XML files, refer to the SMA Cluster Controller user manual.

5 SMA Modbus Profile – Assignment Tables

5.1 Information on the Assignment Tables

The following subsections are sorted by unit ID. Each contains a table of the Modbus addresses which can be accessed under the corresponding unit ID. The tables present the following information:

Information	Explanation
ADR (DEC)	Decimal Modbus address (see Section 3.5.3, page 15 onwards)
Description/Number Code(s)	Short description of the Modbus register and the number codes used.
CNT	Number of assigned Modbus registers.
Type	Data type, e.g. U32 = 32 bits without prefix (see Section 3.7, page 17).
Format	Data format of saved value, e.g. DT = date, FIX n = output with n decimal places, TEMP = output as temperature (see Section 3.8, page 18).
Access	Access type: RW: Read and write (only Modbus TCP) WO: Write only (Modbus TCP and Modbus UDP) If an access type is not allowed, a Modbus exception is generated in the event of access with an access type that is not allowed.

5.2 Gateway (Unit ID = 1)

In the following table you can find the parameters and measured values provided by the gateway which you can access under unit ID = 1, and also the assignment of the SMA devices to the unit IDs. You can access the gateway via the IP address of the Cluster Controller:

ADR (DEC)	Description/number code(s)	CNT (WORD)	Type	Format	Access
30001	Version number of the SMA Modbus profile	2	U32	RAW	RO
30003	SUSy ID (of the Cluster Controller)	2	U32	RAW	RO
30005	Serial number (of the Cluster Controller)	2	U32	RAW	RO
30007	Modbus data change: meter value is increased by the Cluster Controller if new data is available.	2	U32	RAW	RO
30051	Device class: 8000 = All devices 8001 = Solar inverters 8002 = Wind turbine inverter 8007 = Battery inverter 8033 = Consumer 8064 = Sensor system in general 8065 = Electricity meter 8128 = Communication products	2	U32	ENUM	RO
30193	UTC system time (s)	2	U32	DT	RO
30513	Total energy fed in across all line conductors, in Wh (accumulated values of the inverters)	4	U64	FIX0	RO
30517	Energy fed in on current day across all line conductors, in Wh (accumulated values of the inverters)	4	U64	FIX0	RO
30775	Current active power on all line conductors, in W (accumulated values of the inverters)	2	S32	FIX0	RO
30805	Reactive power on all line conductors (VAr), accumulated values of the inverters	2	S32	FIX0	RO

34653	Digital input group 1, coded as status: 311 = Open 2055 = DI1 2056 = DI1 DI2 2057 = DI1 DI2 DI3 2058= DI1 DI2 DI3 DI4 2059 = DI1 DI2 DI4 2060 = DI1 DI3	2062 = DI1 DI4 2063 = DI2 2061 = DI1 DI3 DI4 2064 = DI2 DI3 2065 = DI2 DI3 DI4 2066 = DI2 DI4 2067 = DI3 2068 = DI3 DI4 2069 = DI4	2	U32	ENUM	RO
34655	Digital input group 2, coded as status: 311 = Open 2070 = DI5 2071 = DI5 DI6 2072 = DI5 DI6 DI7 2073 = DI5 DI6 DI7 DI8 2074 = DI5 DI6 DI8 2075 = DI5 DI7	2076 = DI5 DI7 DI8 2077 = DI5 DI8 2078 = DI6 2079 = DI6 DI7 2080 = DI6 DI7 DI8 2081 = DI6 DI8 2082 = DI7 2083 = DI7 DI8 2084 = DI8	2	U32	ENUM	RO
40001	Set UTC plant time, in s		2	U32	DT	RW
Unit ID assignment – SMA devices:						
42109	Device 1: SUSy ID		1	U16	RAW	RO
42110	Device 1: serial number		2	U32	RAW	RO
42112	Device 1: unit ID (e.g. 3)		1	U16	RAW	RW
42113	Device 2: SUSy ID		1	U16	RAW	RO
42114	Device 2: serial number		2	U32	RAW	RO
42116	Device 2: unit ID (e.g. 4)		1	U16	RAW	RW
...	...		...	...	...	...
43085	Device 245: SUSy ID		1	U16	RAW	RO
43086	Device 245: serial number		2	U32	RAW	RO
43088	Device 245: unit ID (e.g. 247)		1	U16	RAW	RW

Unit ID = 255

For unit ID = 255, observe Section 4.3 "Changing Unit IDs via the Gateway", page 21.

Modbus exception on accessing empty assignments

If, in the address range 42109 to 43088, individual Modbus registers or a data block are accessed which do not contain any assignment of unit IDs to SMA devices, a Modbus exception is generated.

5.3 PV System Parameters (Unit ID = 2)

In the following table, you can find the system parameters that you can access using unit ID = 2. The system parameters represent measured values and parameters of the Cluster Controller and also PV system devices that are connected via the Modbus protocol. Parameters such as time settings are transferred by the Cluster Controller to the devices of the PV system and there, depending on the device type, processed further. Measured values such as energy meter values are queried by the devices and made available as accumulated values:

ADR (DEC)	Description/number code(s)	CNT (WORD)	Type	Format	Access
30193	UTC system time, in s	2	U32	DT	RO
30513	Total energy fed in across all line conductors, in Wh (accumulated values of the inverters)	4	U64	FIX0	RO
30517	Energy fed in on current day across all line conductors, in Wh (accumulated values of the inverters)	4	U64	FIX0	RO
30775	Current active power on all line conductors (W), accumulated values of the inverters	2	S32	FIX0	RO
30805	Reactive power on all line conductors (VAr), accumulated values of the inverters	2	S32	FIX0	RO
34609	Ambient temperature (°C)	2	S32	TEMP	RO
34611	Highest measured ambient temperature (°C)	2	S32	TEMP	RO
34613	Total irradiation on the sensor surface (W/m²)	2	U32	FIX0	RO

34615	Wind speed (m/s)		2	U32	FIX1	RO
34617	Humidity (%)		2	U32	FIX2	RO
34619	Air pressure (Pa)		2	U32	FIX2	RO
34621	PV module temperature (°C)		2	S32	TEMP	RO
34623	Total irradiation on the external irradiation sensor/pyranometer (W/m²)		2	U32	FIX0	RO
34625	Ambient temperature (°F)		2	S32	TEMP	RO
34627	Ambient temperature (K)		2	S32	TEMP	RO
34629	PV module temperature (°F)		2	S32	TEMP	RO
34631	PV module temperature (K)		2	S32	TEMP	RO
34633	Wind speed (km/h)		2	U32	FIX1	RO
34635	Wind speed (mph)		2	U32	FIX1	RO
34637	Analog current input 1 (mA)		2	S32	FIX2	RO
34639	Analog current input 2 (mA)		2	S32	FIX2	RO
34641	Analog current input 3 (mA)		2	S32	FIX2	RO
34643	Analog current input 4 (mA)		2	S32	FIX2	RO
34645	Analog voltage input 1 (V)		2	S32	FIX2	RO
34647	Analog voltage input 2 (V)		2	S32	FIX2	RO
34649	Analog voltage input 3 (V)		2	S32	FIX2	RO
34651	Analog voltage input 4 (V)		2	S32	FIX2	RO
34653	Digital input group 1, coded as status: 311 = Open 2055 = DI1 2056 = DI1 DI2 2057 = DI1 DI2 DI3 2058= DI1 DI2 DI3 DI4 2059 = DI1 DI2 DI4 2060 = DI1 DI3	2061 = DI1 DI3 DI4 2062 = DI1 DI4 2063 = DI2 2064 = DI2 DI3 2065 = DI2 DI3 DI4 2066 = DI2 DI4 2067 = DI3 2068 = DI3 DI4 2069 = DI4	2	U32	ENUM	RO

34655	Digital input group 2, coded as status: 311 = Open 2070 = DI5 2071 = DI5 DI6 2072 = DI5 DI6 DI7 2073 = DI5 DI6 DI7 DI8 2074 = DI5 DI6 DI8 2075 = DI5 DI7 2076 = DI5 DI7 DI8 2077 = DI5 DI8 2078 = DI6 2079 = DI6 DI7 2080 = DI6 DI7 DI8 2081 = DI6 DI8 2082 = DI7 2083 = DI7 DI8 2084 = DI8	2	U32	ENUM	RO
40001	Reading and setting the UTC system time (s)	2	U32	DT	RW
40003	Reading and setting the time zone (see Section 8.5 "Number Codes of the Time Zones", page 58).	2	U32	ENUM	RW
40005	Automatic daylight saving time conversion active: 1129 = Active 1130 = Not active	2	U32	ENUM	RW

5.4 SMA Devices (Unit ID = 3 to 247)

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Availability and values of the Modbus registers

Depending on the SMA device used, only certain Modbus registers are available (operating parameters/measured values, see the technical description "Measured values and parameters" at www.SMA-Solar.com). When a Modbus register which is not available for an SMA device is accessed, a Modbus exception is generated (see 3.6 "Reading and Writing of Data", page 15). When a Modbus register containing a non-permitted value is accessed, a NaN corresponding to the type is returned (see Section 3.7.1 "SMA Data Types and NaN Values", page 17).

Value range of cos φ

The value range of cos φ depends on the device. The value range that can be set via the Modbus protocol cannot be converted by every inverter to physical values (displacement power factor cos φ, see the operating manual of the inverter).

In the following table, you can find measured values and parameters for SMA devices that you can access via unit IDs = 3 to 247. The table does not apply for unit IDs 1 and 2.

ADR (DEC)	Description/number code(s)	CNT (WORD)	Type	Format	Access
30051	Device class: 8000 = All devices 8001 = Solar inverters 8002 = Wind turbine inverter 8007 = Battery inverter 8033 = Consumer 8064 = Sensor system in general 8065 = Electricity meter 8128 = Communication products	2	U32	ENUM	RO
30055	Manufacturer specification: 461 = SMA	2	U32	ENUM	RO
30057	Serial number	2	U32	RAW	RO
30059	Software suite	2	U32	FW	RO
30193	UTC system time (s)	2	U32	DT	RO
30197	Event number of the current event. The number of digits is limited by the device (for event messages, see the Technical Description "Measured Values and Parameters").	2	U32	FIX0	RO
30199	Time until grid connection attempt (s)	2	U32	Duration	RO

30201	Status of the device: 35 = Error 303 = Off 307 = OK 455 = Warning	2	U32	ENUM	RO
30203	Power in "OK" status: Displays the maximum active power (W), if the device status is "OK". If the device status is another one, the output is 0 (W).	2	U32	FIX0	RO
30205	Power in "warning" status: Displays the maximum active power, if the device is in the "warning" status (device is currently not feeding in; automatic correction attempt is active). If the device status is another one, the output is 0 (W).	2	U32	FIX0	RO
30207	Power in "error" status: Displays the maximum active power, if the device is in the "error" status (device is no longer feeding in; user action is required). If the device status is another one, the output is 0 (W).	2	U32	FIX0	RO
30211	Recommended action: 336 = Contact manufacturer 337 = Contact installer 338 = Invalid 887 = None	2	U32	ENUM	RO
30213	Status message (code has a maximum of five digits): 886 = No message nnnnn = Last status message The number of digits is limited by the device.	2	U32	ENUM	RO
30215	Status description (code has a maximum of five digits): 885 = No description nnnnn = Last status description The number of digits is limited by the device.	2	U32	ENUM	RO

30217	Utility grid contactor: 51 = Contactor closed 311 = Contactor open	2	U32	ENUM	RO
30219	Temperature derating: 302 = No derating 557 = Temperature derating 884 = Not active 1704 = PMAX derating 1705 = Frequency derating 1706 = Derating due to PV current limitation	2	U32	ENUM	RO
30225	Insulation resistance (Ω)	2	U32	FIX0	RO
30227	Status of key switch: 381 = Switched off 569 = Switched on	2	U32	ENUM	RO
30229	Local time of device	2	U32	DT	RO
30231	Maximum possible permanent active power, fixed configuration. Can be greater than the nominal power (W)	2	U32	FIX0	RO
30233	Permanent active power limitation (W)	2	U32	FIX0	RO
30235	Backup mode status: 1440 = Grid operation 1441 = Stand-alone mode	2	U32	ENUM	RO
30237	Grid type: 1433 = 277 volts 1434 = 208 volts 1435 = 240 volts 1436 = 208 volts without neutral conductor 1437 = 240 volts without neutral conductor	2	U32	ENUM	RO
30239	Operating mode of Power Balancer: 303 = Off 1442 = PhaseGuard 1443 = PowerGuard 1444 = FaultGuard	2	U32	ENUM	RO

30247	Current, complete event number	2	U32	FIX0	RO
30249	Status of the GFDI relay: 51 = Closed 311 = Open	2	U32	ENUM	RO
30251	Status of current restart interlock: 1690 = Fast stop 2386 = Overvoltage 2387 = Undervoltage 2388 = Overfrequency 2389 = Underfrequency 2390 = Passive islanding detection	2	U32	ENUM	RO
30257	State of DC switch: 51 = Closed 311 = Open	2	U32	ENUM	RO
30267 to 30329	DC switch 1 to 32: 51 = Closed 311 = Open	2	U32	ENUM	RO
30331 to 30393	Error message DC switch 1 to 32: 1508 = 90% of the DC switch cycles reached 1509 = 100% of the DC switch cycles reached 1694 = DC switch tripped 1695 = DC switch waiting for connection 1696 = DC switch blocked by spindle 1697 = DC switch manually blocked 1698 = DC switch tripped three times 1699 = DC switch is defective	2	U32	ENUM	RO
30513	Total AC energy fed in on all line conductors (Wh)	4	U64	FIX0	RO
30517	Energy fed in on the current day on all line conductors (Wh)	4	U64	FIX0	RO
30521	Operating time (s)	4	U64	Duration	RO
30525	Feed-in time (s)	4	U64	Duration	RO
30529	Total AC energy fed in on all line conductors (Wh)	2	U32	FIX0	RO

30531	Total AC energy fed in on all line conductors (kWh)	2	U32	FIX0	RO
30533	Total AC energy fed in on all line conductors (MWh)	2	U32	FIX0	RO
30535	Energy fed in on the current day on all line conductors (Wh)	2	U32	FIX0	RO
30537	Energy fed in on the current day on all line conductors (kWh)	2	U32	FIX0	RO
30539	Energy fed in on the current day on all line conductors (MWh)	2	U32	FIX0	RO
30541	Operating time (s)	2	U32	Duration	RO
30543	Feed-in time (s)	2	U32	Duration	RO
30545	Operating time of interior fan 1 (s)	2	U32	Duration	RO
30547	Operating time of interior fan 2 (s)	2	U32	Duration	RO
30549	Operating time of heat sink fan (s)	2	U32	Duration	RO
30559	Number of events at user level	2	U32	FIX0	RO
30561	Number of events at installer level	2	U32	FIX0	RO
30565	Number of generator starts	2	U32	FIX0	RO
30567	Meter for battery charging ampere-hours (Ah)	2	U32	FIX0	RO
30569	Meter for battery discharging in ampere-hours (Ah)	2	U32	FIX0	RO
30571	Meter reading consumption meter (Wh)	2	U32	FIX0	RO
30573	Operating time of generator (s)	2	U32	Duration	RO
30575	Released energy from generator (Wh)	2	U32	FIX0	RO
30577	Purchased electricity today (Wh)	2	U32	FIX0	RO
30579	Feed-in today (Wh)	2	U32	FIX0	RO
30581	Meter reading of purchased electricity meter (Wh)	2	U32	FIX0	RO
30583	Meter reading of grid feed-in meter (Wh)	2	U32	FIX0	RO
30585	Power outage time (s)	2	U32	Duration	RO
30587	Meter reading of PV production meter (Wh)	2	U32	FIX0	RO
30589	Total increased self-consumption (Wh)	2	U32	FIX0	RO

30591	Increased self-consumption today (Wh)	2	U32	FIX0	RO
30593	Total energy consumed internally (Wh)	2	U32	FIX0	RO
30595	Consumed energy (Wh)	2	U32	FIX0	RO
30597	Fed energy (Wh)	2	U32	FIX0	RO
30599	Number of grid connections	2	U32	FIX0	RO
30769	DC current input (A)	2	S32	FIX3	RO
30771	DC voltage input (V)	2	S32	FIX2	RO
30773	DC power input (W)	2	S32	FIX0	RO
30775	Active power on all line conductors (W)	2	S32	FIX0	RO
30777	Active power of line conductor L1 (W)	2	S32	FIX0	RO
30779	Active power of line conductor L2 (W)	2	S32	FIX0	RO
30781	Active power of line conductor L3 (W)	2	S32	FIX0	RO
30783	Line voltage, line conductor L1 to N (V)	2	U32	FIX2	RO
30785	Line voltage, line conductor L2 to N (V)	2	U32	FIX2	RO
30787	Line voltage, line conductor L3 to N (V)	2	U32	FIX2	RO
30789	Line voltage, line conductor L1 to L2 (V)	2	U32	FIX2	RO
30791	Line voltage, line conductor L2 to L3 (V)	2	U32	FIX2	RO
30793	Line voltage, line conductor L3 to L1 (V)	2	U32	FIX2	RO
30795	Line current on all line conductors (A)	2	U32	FIX3	RO
30797	Line current of line conductor L1 (A)	2	U32	FIX3	RO
30799	Line current of line conductor L2 (A)	2	U32	FIX3	RO
30801	Line current of line conductor L3 (A)	2	U32	FIX3	RO
30803	Power frequency (Hz)	2	U32	FIX2	RO
30805	Reactive power on all line conductors (VAr)	2	S32	FIX0	RO
30807	Reactive power of line conductor L1 (VAr)	2	S32	FIX0	RO
30809	Reactive power of line conductor L2 (VAr)	2	S32	FIX0	RO
30811	Reactive power of line conductor L3 (VAr)	2	S32	FIX0	RO

30813	Apparent power on all line conductors (VA)	2	S32	FIX0	RO
30815	Apparent power of line conductor L1 (VA)	2	S32	FIX0	RO
30817	Apparent power of line conductor L2 (VA)	2	S32	FIX0	RO
30819	Apparent power of line conductor L3 (VA)	2	S32	FIX0	RO
30821	Total displacement power factor of all line conductors	2	U32	FIX2	RO
30823	Excitation type of cos φ: 1041 = Leading 1042 = Lagging	2	U32	ENUM	RO
30825	Operating mode of the reactive power regulation: 303 = Off 1069 = Reactive power/voltage characteristic curve Q(V) 1070 = Reactive power Q, direct setpoint 1071 = Reactive power const. Q (kVAr) 1072 = Reactive power Q, setpoint via system control 1073 = Reactive power Q(P) 1074 = cos φ, direct setpoint 1075 = cos φ, setpoint via system control 1076 = cos φ(P) characteristic curve 1387 = Reactive power Q, setpoint via analog input 1388 =cos φ, setpoint via analog input 1389 = Reactive power/voltage characteristic curve Q(V) with hysteresis and deadband	2	U32	ENUM	RO
30827	Reactive power setpoint (VAr)	2	S32	FIX0	RO
30829	Reactive power setpoint (%)	2	S32	FIX1	RO
30831	Setpoint of cos φ	2	S32	FIX2	RO
30833	Setpoint, excitation type of cos φ: 1041 = Leading 1042 = Lagging	2	U32	ENUM	RO

30835	Operating mode of active power limitation: 303 = Off 1077 = Active power limitation P (W) 1078 = Active power limitation P (%) of PMAX 1079 = Active power limitation P via system control 1390 = Active power limitation P via analog input 1391 = Active power limitation P via digital inputs	2	U32	ENUM	RO
30837	Active power setpoint (W)	2	U32	FIX0	RO
30839	Active power setpoint (%)	2	U32	FIX0	RO
30843	Battery current (A)	2	S32	FIX3	RO
30845	Current battery state of charge (%)	2	U32	FIX0	RO
30847	Current battery capacity (%)	2	U32	FIX0	RO
30849	Battery temperature (°C)	2	S32	TEMP	RO
30851	Battery voltage (V)	2	U32	FIX2	RO
30853	Active battery charging mode: 1767 = Boost charge 1768 = Full charge 1769 = Equalization charge 1770 = Float charge	2	U32	ENUM	RO
30855	Current battery charging voltage setpoint (V)	2	U32	FIX2	RO
30857	Number of battery charge throughputs	2	S32	FIX0	RO
30859	Battery maintenance charge status: 803 = Inactive 1771 = Charge with solar power 1772 = Charge with solar and line current	2	U32	ENUM	RO
30861	Load power (W)	2	S32	FIX0	RO
30863	Current generator power (W)	2	U32	FIX0	RO
30865	Power - purchased electricity (W)	2	S32	FIX0	RO
30867	Power grid feed-in (W)	2	S32	FIX0	RO
30869	Power PV generation (W)	2	S32	FIX0	RO

30871	Current self-consumption (W)	2	U32	FIX0	RO
30873	Current increased self-consumption (W)	2	S32	FIX0	RO
30875	Multifunction relay status: 51 = Closed 311 = Open	2	U32	ENUM	RO
30877	Electricity supply status: 303 = Off 1461 = Utility grid connected 1462 = Backup not available 1463 = Backup	2	U32	ENUM	RO
30879	Reason for requesting generator: 1773 = No request 1774 = Load 1775 = Time control 1776 = Manual one hour 1777 = Manual start 1778 = External source	2	U32	ENUM	RO
30881	PV system utility grid connection: 1779 = Disconnected 1780 = Utility grid 1781 = Stand-alone grid	2	U32	ENUM	RO
30883	Status of utility grid: 303 = Off 1394 = Wait for valid AC grid 1461 = Utility grid connected 1466 = Waiting 1787 = Initialization 2183 = Grid operation without feed-back 2184 = Energy saving in the utility grid 2185 = End energy saving in the utility grid 2186 = Start energy saving in the utility grid	2	U32	ENUM	RO
30885	Power of external grid connection (W)	2	U32	FIX0	RO

30887	Power of external grid connection of line conductor A (W)	2	U32	FIX0	RO
30889	Power of external grid connection of line conductor B (W)	2	U32	FIX0	RO
30891	Power of external grid connection of line conductor C (W)	2	U32	FIX0	RO
30893	Reactive power of external grid connection (VAr)	2	U32	FIX0	RO
30895	Reactive power of external grid connection of line conductor A (VAr)	2	U32	FIX0	RO
30897	Reactive power of external grid connection of line conductor B (VAr)	2	U32	FIX0	RO
30899	Reactive power of external grid connection of line conductor C (VAr)	2	U32	FIX0	RO
30901	Power frequency of external grid connection (Hz)	2	U32	FIX2	RO
30903	Voltage of external grid connection of line conductor A (V)	2	U32	FIX2	RO
30905	Voltage of external grid connection of line conductor B (V)	2	U32	FIX2	RO
30907	Voltage of external grid connection of line conductor C (V)	2	U32	FIX2	RO
30909	Current of external grid connection of line conductor A (A)	2	S32	FIX3	RO
30911	Current of external grid connection of line conductor B (A)	2	S32	FIX3	RO
30913	Current of external grid connection of line conductor C (A)	2	S32	FIX3	RO
30915	Electricity supply status: 303 = Off 1461 = Utility grid connected 1462 = Backup not available 1463 = Backup	2	U32	ENUM	RO

30917	Generator state: 303 = Off 1392 = Error 1787 = Initialization 1788 = Ready 1789 = Warm-up 1790 = Synchronize 1791 = Activated 1792 = Resynchronization 1793 = Generator separation 1794 = Shut-off delay 1795 = Blocked 1796 = Blocked after error	2	U32	ENUM	RO
30919	Operating mode of static voltage stability with "Q at Night": 303 = Off 1069 = Reactive power/voltage characteristic curve Q(V) 1070 = Reactive power Q, direct setpoint 1071 = Reactive power const. Q (kVAr) 1072 = Reactive power Q, setpoint via system control 1387 = Reactive power Q, setpoint via analog input 1389 = Reactive power/voltage characteristic curve Q(V) with hysteresis and deadband	2	U32	ENUM	RO
30921	Reactive power setpoint with "Q at Night" (VAr)	2	S32	FIX0	RO
30923	Reactive power setpoint with "Q at Night" (%)	2	S32	FIX1	RO
31793 to 31919	String current of strings 1 to 64 (A)	2	S32	FIX3	RO
31921 to 31983	String current of strings 65 to 96 (A)	2	S32	FIX3	RO

31985 to 32047	String current of strings 97 to 128 (A)	2	S32	FIX3	RO
32049	ID of current measurement unit where a communication error has occurred	2	U32	FIX0	RO
32051	Warning code for error of string monitoring unit	2	U32	FIX2	RO
34097	Operating time of interior fan 1 (s)	4	U64	Duration	RO
34101	Operating time of interior fan 2 (s)	4	U64	Duration	RO
34105	Operating time of heat sink fan (s)	4	U64	Duration	RO
34109	Heat sink temperature 1 (°C)	2	S32	TEMP	RO
34113	Interior temperature 1 (°C)	2	S32	TEMP	RO
34121	Transformer temperature 1 (°C)	2	S32	TEMP	RO
34125	External temperature 1 of supply air (°C)	2	S32	TEMP	RO
34127	Highest measured external temperature 1 (°C)	2	S32	TEMP	RO
34609	Ambient temperature (°C)	2	S32	TEMP	RO
34611	Highest measured ambient temperature (°C)	2	S32	TEMP	RO
34613	Total irradiation on the sensor surface (W/m²)	2	U32	FIX0	RO
34615	Wind speed (m/s)	2	U32	FIX1	RO
34617	Humidity (%)	2	U32	FIX2	RO
34619	Air pressure (Pa)	2	U32	FIX2	RO
34621	PV module temperature (°C)	2	S32	TEMP	RO
34623	Total irradiation on the external irradiation sensor/pyranometer (W/m²)	2	U32	FIX0	RO
34625	Ambient temperature (°F)	2	S32	TEMP	RO
34627	Ambient temperature (K)	2	S32	TEMP	RO
34629	PV module temperature (°F)	2	S32	TEMP	RO
34631	PV module temperature (K)	2	S32	TEMP	RO
34633	Wind speed (km/h)	2	U32	FIX1	RO

34635	Wind speed (mph)		2	U32	FIX1	RO
34637	Analog current input 1 (mA)		2	S32	FIX2	RO
34639	Analog current input 2 (mA)		2	S32	FIX2	RO
34641	Analog current input 3 (mA)		2	S32	FIX2	RO
34643	Analog current input 4 (mA)		2	S32	FIX2	RO
34645	Analog voltage input 1 (V)		2	S32	FIX2	RO
34647	Analog voltage input 2 (V)		2	S32	FIX2	RO
34649	Analog voltage input 3 (V)		2	S32	FIX2	RO
34651	Analog voltage input 4 (V)		2	S32	FIX2	RO
34653	Digital input group 1, coded as status: 311 = Open 2055 = DI1 2056 = DI1 DI2 2057 = DI1 DI2 DI3 2058= DI1 DI2 DI3 DI4 2059 = DI1 DI2 DI4 2060 = DI1 DI3	2061 = DI1 DI3 DI4 2062 = DI1 DI4 2063 = DI2 2064 = DI2 DI3 2065 = DI2 DI3 DI4 2066 = DI2 DI4 2067 = DI3 2068 = DI3 DI4 2069 = DI4	2	U32	ENUM	RO
34655	Digital input group 2, coded as status: 311 = Open 2070 = DI5 2071 = DI5 DI6 2072 = DI5 DI6 DI7 2073 = DI5 DI6 DI7 DI8 2074 = DI5 DI6 DI8 2075 = DI5 DI7	2076 = DI5 DI7 DI8 2077 = DI5 DI8 2078 = DI6 2079 = DI6 DI7 2080 = DI6 DI7 DI8 2081 = DI6 DI8 2082 = DI7 2083 = DI7 DI8 2084 = DI8	2	U32	ENUM	RO
35377	Number of events for user		4	U64	FIX0	RO
35381	Number of events for installer		4	U64	FIX0	RO
40001	Reading and setting the UTC system time (s)		2	U32	DT	RW

40003	Reading and setting the time zone (see Section 8.5 "Number Codes of the Time Zones", page 58).	2	U32	ENUM	RW
40005	Automatic daylight saving time conversion active: 1129 = Active 1130 = Not active	2	U32	ENUM	RW
40009	Operating state: 295 = MPP 381 = Stop 443 = Constant voltage 1855 = Stand-alone operation 3128 = Remote control by SMA Service	2	U32	ENUM	RW
40011	Acknowledgement: 26 = Acknowledge error	2	U32	ENUM	RW
40013	Set language: 777 = German 778 = English 779 = Italian 780 = Spanish 781 = French 782 = Greek 783 = Korean 784 = Czech 785 = Portuguese 786 = Dutch 796 = Slovenian 797 = Bulgarian 798 = Polish 799 = Japanese 801 = Thai 804 = Hebrew	2	U32	ENUM	RW
40020	External measurement of the insulation resistance: 303 = Off 308 = On	2	U32	ENUM	RW
40029	Operating status: 295 = MPP 381 = Stop 1392 = Error 1393 = Wait for DC start conditions 1467 = Start 1469 = Shut down 1480 = Wait for electric utility company 2119 = Derating	2	U32	ENUM	RO

40031	Nominal capacity of the battery (Ah)	2	U32	FIX0	RO
40033	Maximum battery temperature (°C)	2	U32	TEMP	RW
40035	Battery type: 1782 = Valve-regulated lead-acid battery (VRLA) 1783 = Flooded lead-acid battery (FLA) 1784 = Nickel/Cadmium (NiCd) 1785 = Lithium-Ion (Li-Ion)	2	U32	ENUM	RO
40037	Nominal battery voltage (V)	2	U32	FIX0	RO
40039	Time for boost charge of battery (min)	2	U32	Duration	RW
40041	Time for equalization charge of battery (h)	2	U32	Duration	RW
40043	Time for full charge of battery (h)	2	U32	Duration	RW
40045	Maximum battery charging current (A)	2	U32	FIX3	RW
40047	Nominal generator current (A)	2	U32	FIX3	RW
40049	Automatic generator start: 1129 = Yes 1130 = No	2	U32	ENUM	RW
40051	Battery state of charge limit for generator shutdown (%)	2	U32	FIX0	RW
40053	Battery state of charge limit for generator start (%)	2	U32	FIX0	RW
40055	Manual generator control: 381 = Stop 1467 = Start	2	U32	ENUM	RW
40057	Generator request via power on: 1129 = Yes 1130 = No	2	U32	ENUM	RW
40059	Generator shutdown load limit (W)	2	U32	FIX0	RW
40061	Generator start load limit (W)	2	U32	FIX0	RW
40063	Firmware version of the central assembly	2	U32	FW	RO
40065	Firmware version of the logic component	2	U32	FW	RO

40067	Serial number	2	U32	RAW	RO
40071	Grid-forming generator: 1799 = None 1801 = Utility grid 1802 = Utility grid and generator 1803 = Invalid configuration for the PV production meter	2	U32	ENUM	RW
40073	Lower discharging limit for increased self-consumption (%)	2	U32	FIX0	RW
40075	Increased self-consumption switched on 1129 = Yes 1130 = No	2	U32	ENUM	RW
40077	Initiate device restart: 1146 = Execute	2	U32	ENUM	RW
40079	Battery final cut-off voltage (V)	2	U32	FIX2	RW
40081	Maximum charge current of battery (A)	2	U32	FIX3	RW
40083	Maximum discharge current of battery (A)	2	U32	FIX3	RW
40085	Cell charging set voltage for boost charge (V)	2	U32	FIX2	RW
40087	Cell charging set voltage for full charge (V)	2	U32	FIX2	RW
40089	Cell charging set voltage for equalization charge (V)	2	U32	FIX2	RW
40091	Cell charging set voltage for float charge (V)	2	U32	FIX2	RW
40093	Voltage monitoring minimum threshold (V)	2	U32	FIX2	RW
40095	Voltage monitoring maximum threshold (V)	2	U32	FIX2	RW
40097	Voltage monitoring hysteresis minimum threshold (V)	2	U32	FIX2	RW
40099	Voltage monitoring hysteresis maximum threshold (V)	2	U32	FIX2	RW
40101	Frequency monitoring minimum threshold (Hz)	2	U32	FIX2	RW
40103	Frequency monitoring maximum threshold (Hz)	2	U32	FIX2	RW

40105	Frequency monitoring hysteresis minimum threshold (Hz)	2	32	FIX2	RW
40107	Frequency monitoring hysteresis maximum threshold (Hz)	2	32	FIX2	RW
40109	Set country standard: 27 = Special setting 42 = AS4777.3 305 = Stand-alone mode 333 = PPC 343 = RD1663 438 = VDE0126-1-1 1013 = Other standard	2	U32	ENUM	RO
40111	Voltage monitoring generator minimum threshold (V)	2	U32	FIX2	RW
40113	Voltage monitoring generator maximum threshold (V)	2	U32	FIX2	RW
40115	Voltage monit. gener. hysteresis min. threshold (V)	2	U32	FIX2	RW
40117	Voltage monit. generator hysteresis maximum threshold (V)	2	U32	FIX2	RW
40119	Frequency monitoring generator minimum threshold (Hz)	2	U32	FIX2	RW
40121	Frequency monitoring generator maximum threshold (Hz)	2	U32	FIX2	RW
40123	Frequency monitoring generator hysteresis minimum threshold (Hz)	2	U32	FIX2	RW
40125	Frequency monitoring generator hysteresis maximum threshold (Hz)	2	U32	FIX2	RW
40127	Voltage monitoring generator maximum reverse power (W)	2	U32	FIX2	RW
40129	Voltage monitoring generator maximum reverse power trip. time (s)	2	U32	Duration	RW

40131	Grid connection point nominal current (A)	2	U32	FIX2	RW
40133	Utility grid nominal voltage (V)	2	U32	FIX0	RW
40135	Nominal frequency (Hz)	2	U32	FIX2	RW
40137	Acknowledge generator errors: 26 = Acknowledge error	2	U32	ENUM	RW
40141	Maximum start attempts after error	2	U32	FIX0	RW
40143	Active power setpoint (A), for operating mode Active power limitation P through PV system control	2	S32	FIX2	RW
40145	Reactive current setpoint (A) for the operating mode Specification by system control	2	S32	FIX2	RW
40147	Generator active power limitation (A) for operating mode Active power limitation P through system control	2	U32	FIX2	RW
40149	Active power setpoint (W), for operating mode Active power limitation P through system control	2	S32	FIX0	RW
40151	System control (active and reactive power control via communication): 802 = Active 803 = Inactive	2	U32	ENUM	RW
40153	Reactive power setpoint (VAr) for operating mode Specification by system control	2	S32	FIX0	RW
40200	Operating mode of the reactive power control: 303 = Off 1069 = Reactive power/voltage characteristic curve Q(V) 1070 = Reactive power Q, direct setpoint 1071 = Reactive power const. Q (kVAr) 1072 = Reactive power Q, setpoint via system control 1073 = Reactive power Q(P) 1074 = cos φ, direct setpoint 1075 = cos φ, setpoint via system control 1076 = cos φ(P) characteristic curve 1387 = Reactive power Q, setpoint via analog input 1388 = cos φ, setpoint via analog input 1389 = Reactive power/voltage characteristic curve Q(V) with hysteresis and deadband	2	U32	ENUM	RW

40202	Reactive power setpoint (VAr)	2	S32	FIX0	RW
40204	Reactive power setpoint (%)	2	S32	FIX1	RW
40206	Setpoint of cos φ	2	S32	FIX2	RW
40208	Setpoint of excitation type of cos φ: 1041 = Leading 1042 = Lagging	2	U32	ENUM	RW
40210	Operating mode of active power limitation 303 = Off 1077 = Active power limitation P (W) 1078 = Active power limitation P (%) of PMAX 1079 = Active power limitation P via system control 1390 = Active power limitation P via analog input 1391 = Active power limitation P via digital inputs	2	U32	ENUM	RW
40212	Active power setpoint (W)	2	U32	FIX0	RW
40214	Active power setpoint (%)	2	U32	FIX0	RW
40216	Operating mode of active power limitation at overfrequency P(f): 303 = Off 1132 = Linear gradient for instantaneous power	2	U32	ENUM	RW
40218	Configuration of the linear gradient of the instantaneous power: Difference between starting frequency and power frequency (Hz)	2	U32	FIX2	RW
40220	Configuration of the linear gradient of the instantaneous power: Difference between reset frequency and power frequency (Hz)	2	U32	FIX2	RW
40222	Configuration of the cos φ(P) characteristic curve: cos φ of the starting point	2	U32	FIX2	RW
40224	Configuration of the cos φ (P) characteristic curve (excitation type of the starting point): 1041 = Leading 1042 = Lagging	2	U32	ENUM	RW

40226	Configuration of the cos φ (P) characteristic curve: cos φ of the end point	2	U32	FIX2	RW
40228	Configuration of the cos φ (P) characteristic curve: (excitation type of the end point): 1041 = Leading 1042 = Lagging	2	U32	ENUM	RW
40230	Configuration of the cos φ (P) characteristic curve: active power of the starting point (%)	2	U32	FIX0	RW
40232	Configuration of the cos φ (P) characteristic curve: active power of the end point (%)	2	U32	FIX0	RW

6 User-Defined Modbus Profile

With the user-defined Modbus profile, the Modbus addresses that are available in the SMA Modbus profile for the individual unit IDs can be assigned to different Modbus addresses. You can use the entire Modbus address range from 0 to 65535. One advantage of the user-defined Modbus profile can be that the measured values and parameters relevant for controlling your plant can be applied to consecutive Modbus addresses. These addresses can then be read or written in a single data block.

The user-defined Modbus profile can be called up via the gateway like an additional device and has a separate unit ID which you can define between 3 and 247 (see Section 3.5.1 "Unit IDs", page 14).

6.1 Structure of the XML File for the User-Defined Modbus Profile

The user-defined Modbus profile is created in the file **usrprofile.xml** .

The XML file's basic structure looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<virtual_modbusprofile>
        <channel unitid="aaa" source="bbbbb" destination="ccccc" />
        ...
        <!–End of the instructions–>
</virtual_modbusprofile>
```

Legend for XML tags and attributes:

XML tag or attribute	Explanation
<virtual_modbusprofile> </virtual_modbusprofile>	A user-definded Modbus profile is created within this XML structure.
<channel />	Within a channel tag, a Modbus address of a unit ID is redefined:
unitid="aaa"	Specifies the unit ID of the device which Modbus addresses are to be used as a source. Available unit IDs for individual devices are 3 to 247.
source="bbbbb"	Specifies a Modbus address of the devices selected under "unitid", whose parameters or measured values are to be used as source (see Section 5 "Assignment Tables", page 26).

destination="ccccc"	Specifies the new Modbus address at which the parameter or measured value is to be accessed (0 to 65535). Note the number of Modbus registers that are stored at the initial address. The destination registers must not overlap. If incomplete Modbus registers are called up later, a Modbus exception is generated. If register addresses are called up, which are not filled with values, NaN is returned.
<!--xyz-->	Comments out the range xyz, for example, to deactivate an instruction.

Modbus exceptions

Modbus exceptions, see "Modbus Application Protocol Specification" at http://www.modbus.org/specs.php.

6.2 Example of a User-Defined Modbus Profile

The Modbus registers for apparent power, active power and reactive power of the devices stored under unit IDs 3 and 4 are to be retrievable in a user-defined Modbus profile from address 0 at consecutive Modbus addresses (the following table is an excerpt from the SMA Modbus profile):

ADR (DEC)	Description/number code(s)	CNT (WORD)	Type	Format	Access
30775	AC active power on all line conductors (W)	2	S32	FIX0	RO
30805	Reactive power on all line conductors (VAr)	2	S32	FIX0	RO
30813	Apparent power on all line conductors (VA)	2	S32	FIX0	RO

The exact appearance of the XML file follows from the example:

```
<?xml version="1.0" encoding="UTF-8"?>
<virtual_modbusprofile>
        <channel unitid="3" source="30775" destination="0" />
        <channel unitid="3" source="30805" destination="2" />
        <channel unitid="3" source="30813" destination="4" />
        <channel unitid="4" source="30775" destination="6" />
        <channel unitid="4" source="30805" destination="8" />
        <channel unitid="4" source="30813" destination="10" />
</virtual_modbusprofile>
```

6.3 Activating and Deactivating User-Defined Modbus Profile

To activate your user-defined Modbus profile, upload the file **usrprofile.xml** to the Cluster Controller, restart it, and activate the user-defined Modbus profile as described below.

If the usage of the user-defined Modbus profile on the Cluster Controller is deactivated, the user-defined assignments are lost and only the SMA Modbus profile remains active.

Uploading and downloading XML files

For more information on uploading and downloading XML files via the user interface, see the SMA Cluster Controller user manual.

Activating a User-Defined Modbus Profile

You activate a user-defined Modbus profile by creating a device entry with the attribute "susyid=0" in file **usrplant.xml** (you can find more information on the file usrplant.xml in Section 4.4 "Changing Unit IDs via the XML File usrplant.xml", page 23).

Example:

The following device entry activates a user-defined Modbus profile that is entered as the tenth device in the gateway.

<device regoffs=”9“ susyid=”0“ serial=”0“ unitid=”100“ />

Deactivating a User-Defined Modbus profile

You deactivate a user-defined Modbus profile by commenting out in its device line in the file **usrplant.xml** and re-uploading this to the Cluster Controller (for more information on the usrplant.xml file, see Section 4.4 "Changing Unit IDs via the XML File usrplant.xml", page 23).

In the following example, you can see a commenting out applied to the line with the user-defined Modbus profile:

<!- -<device regoffs="0" susyid="128" serial="8700654300" unitid="3" />- ->

7 Troubleshooting

You can find information on error analysis of the SMA Modbus profile in Section 3.6 "Reading and Writing of Data", page 15.

For troubleshooting of the SMA devices, go to Modbus address 30197 and use the event numbers displayed here.

The event numbers of the SMA devices cannot be decrypted with the number codes in this document

The event numbers of the SMA devices are device-specific and cannot be decrypted with the number codes in this document.

To decrypt the event numbers of low or medium-power inverters, you require additional information (operating parameters/measured values, see Technical Description "Measured Values and Parameters" at www.SMA-Solar.com).

To decrypt the event numbers of central inverters, contact the SMA Service Line (see Section 9 "Contact", page 61).

8 Technical Data

8.1 Supported SMA Inverters

All inverters with integrated or retrofitted Speedwire/Webconnect interfaces are supported.

Information on whether an inverter has an integrated Speedwire/Webconnect interface or can be retrofitted with a Speedwire/Webconnect interface can be found on the product page of the respective inverter at
www.SMA-Solar.com.

8.2 Number of SMA Devices

The following table contains details on the maximum number of SMA devices that can be operated with the Cluster Controller.

Device type	Maximum number of SMA devices
CLCON-10	75
CLCON-S-10	25

8.3 Modbus Communication Ports

The following table shows the default settings of the supported network protocols:

Network protocol	Communication port, default setting
TCP	502
UDP	502

Use free communication ports

You should only use free communication ports. The following range is generally available: 49152 to 65535.

You can find more information on occupied ports in the database "Service Name and Transport Protocol Port Number Registry" at http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml.

Changing the communication port

If you change one of the Modbus ports of the Cluster Controller, you must also change the corresponding Modbus port of a connected Modbus master system. Otherwise, the Cluster Controller can no longer be accessed via the Modbus protocol.

8.4 Data Processing and Time Behavior

In this Section, you can find typical data processing and reaction times of the Cluster Controller Modbus interface and time details for saving parameters in SMA devices.

NOTICE

Damage to SMA inverters

The parameters of the SMA inverters that can be changed with writable Modbus registers (RW) are intended for long-term storage of device settings. Cyclical changing of these parameters leads to destruction of the flash memory of the devices.

- Device parameters must not be changed cyclically.

Contact the SMA Service Line if you would like to automate the remote control of your PV system (see Section 9 "Contact", page 61).

Signal Run Time through the Cluster Controller

The signal run time through the Cluster Controller is a maximum of 100 ms.

The signal run time is the time required by the Cluster Controller to process incoming Modbus commands and to forward them to the devices in the PV system.

Data Transfer Interval via the Modbus Protocol

For system stability reasons, the time period between data transfers via the Modbus protocol must be at least ten seconds. No more than 30 parameters and measured values should be transmitted per inverter. Note the maximum number of SMA devices according to Section 8.2 "Number of SMA Devices", page 56.

Physical Reaction Time of the Inverters

The physical reaction time of the inverters is typically approximately one second, depending on the inverters used.

The physical reaction time is the time between the changing of setpoints in the inverters until their physical implementation. Such a change would be, for example, changing cos φ.

Reaction Time of the Modbus Interface

The reaction time of the Modbus interface is five to ten seconds

The reaction time of the Modbus interface is the time between the arrival of the parameter specifications in the inverters until the corresponding measured values are provided to the Modbus interface of the Cluster Controller. Due to this reaction time, parameter specifications can only be displayed via a Modbus master system (e.g. a SCADA system) at a corresponding or larger interval.

8.5 Number Codes of the Time Zones

The following table contains the most important time zones and their number codes in the SMA Modbus profile. If the location is known, you can determine the numerical key (code) and the time zone. In the tables in Section 5 "SMA Modbus Profile – Assignment Tables", from page 26, with specification of the time zone, this table is referenced.

City/Country	Code	Time zone
Abu Dhabi, Muscat	9503	UTC+04:00
Adelaide	9513	UTC+09:30
Alaska	9501	UTC-09:00
Amman	9542	UTC+02:00
Amsterdam, Berlin, Bern, Rome, Stockholm, Vienna	9578	UTC+01:00
Arizona	9574	UTC-07:00
Astana, Dhaka	9515	UTC+06:00
Asuncion	9594	UTC-04:00
Athens, Bucharest, Istanbul	9537	UTC+02:00
Atlantic (Canada)	9505	UTC-04:00
Auckland, Wellington	9553	UTC+12:00
Azores	9509	UTC-01:00
Bagdad	9504	UTC+03:00
Baku	9508	UTC+04:00
Bangkok, Hanoi, Jakarta	9566	UTC+07:00
Beijing, Chongqing, Hong Kong, Ürümqi	9522	UTC+08:00
Beirut	9546	UTC+02:00
Belgrade, Bratislava, Budapest, Ljubljana, Prague	9517	UTC+01:00
Bogotá, Lima, Quito	9563	UTC-05:00
Brasilia	9527	UTC-03:00
Brisbane	9525	UTC+10:00
Brussels, Copenhagen, Madrid, Paris	9560	UTC+01:00
Buenos Aires	9562	UTC-03:00
Cairo	9529	UTC+02:00
Canberra, Melbourne, Sydney	9507	UTC+10:00
Cape Verde Islands	9511	UTC-01:00
Caracas	9564	UTC-04:30
Casablanca	9585	UTC+00:00
Caucasus Standard Time	9582	UTC+04:00
Cayenne	9593	UTC-03:00
Central America	9520	UTC-06:00
Chennai, Kolkata, Mumbai, New Delhi	9539	UTC+05:30
Chicago, Dallas, Kansas City, Winnipeg	9583	UTC-06:00
Chihuahua, La Paz, Mazatlán	9587	UTC-07:00
Darwin	9506	UTC+09:30
Denver, Salt Lake City, Calgary	9547	UTC-07:00
Dublin, Edinburgh, Lisbon, London	9534	UTC+00:00
Fiji, Marshall Islands	9531	UTC+12:00
Georgetown, La Paz, San Juan	9591	UTC-04:00
Greenland	9535	UTC-03:00
Guadalajara, Mexico City, Monterrey	9584	UTC-06:00
Guam, Port Moresby	9580	UTC+10:00
Harare, Pretoria	9567	UTC+02:00
Hawaii	9538	UTC-10:00
Helsinki, Kiev, Riga, Sofia, Tallinn, Vilnius	9532	UTC+02:00
Hobart	9570	UTC+10:00
Indiana (East)	9573	UTC-05:00
International Date Line (West)	9523	UTC-12:00
Irkutsk	9555	UTC+08:00
Islamabad, Karachi	9579	UTC+05:00
Jerusalem	9541	UTC+02:00
Kabul	9500	UTC+04:30
Katmandu	9552	UTC+05:45
Krasnoyarsk	9556	UTC+07:00
Kuala Lumpur, Singapore	9544	UTC+08:00
Kuwait, Riyadh	9502	UTC+03:00
Magadan, Solomon Islands, New Caledonia	9519	UTC+11:00
Manaus	9516	UTC-04:00
Mid-Atlantic	9545	UTC-02:00
Midway Islands, Samoa	9565	UTC-11:00
Minsk	9526	UTC+02:00
Monrovia, Reykjavík	9536	UTC+00:00

Montevideo	9588	UTC-03:00
Moscow, St. Petersburg, Volgograd	9561	UTC+03:00
Nairobi	9524	UTC+03:00
New York, Miami, Atlanta, Detroit, Toronto	9528	UTC-05:00
Newfoundland	9554	UTC-03:30
Novosibirsk	9550	UTC+06:00
Nuku'alofa	9572	UTC+13:00
Osaka, Sapporo, Tokyo	9571	UTC+09:00
Pacific (USA, Canada)	9558	UTC-08:00
Perth	9576	UTC+08:00
Petropavlovsk-Kamchatsky	9595	UTC+12:00
Port Louis	9586	UTC+04:00
Santiago	9557	UTC-04:00
Sarajevo, Skopje, Warsaw, Zagreb	9518	UTC+01:00
Saskatchewan	9510	UTC-06:00
Seoul	9543	UTC+09:00
Sri Jayawardenepura	9568	UTC+05:30
Taipei	9569	UTC+08:00
Tashkent	9589	UTC+05:00
Tbilisi	9533	UTC+04:00
Teheran	9540	UTC+03:30
Tijuana, Lower California (Mexico)	9559	UTC-08:00
Ulan Bator	9592	UTC+08:00
Vladivostok	9575	UTC+10:00
West-Central Africa	9577	UTC+01:00
Windhoek	9551	UTC+02:00
Yakutsk	9581	UTC+09:00
Yangon (Rangoon)	9549	UTC+06:30
Yekaterinburg	9530	UTC+05:00
Yerevan	9512	UTC+04:00

8.6 Frequently Used Number Codes (ENUM)

The following table contains number codes which, as function coding in data format ENUM, are frequently used in the SMA Modbus profile.

Event Numbers

The event numbers displayed by the inverters under the Modbus address 30197 are device-specific. You cannot decrypt the event numbers with the number codes in this document (see Section 7 "Troubleshooting", page 55).

Code	Meaning
51	Closed
276	Instantaneous value
295	MPP
303	Off
308	On
309	Operation
311	Open
336	Contact the manufacturer
337	Contact the installer
338	Invalid
381	Stop
455	Warning
461	SMA (manufacturer specification)
1041	leading
1042	lagging
1069	Reactive power/voltage characteristic curve Q(V)
1070	Reactive power Q, direct setpoint
1071	Reactive power const. Q (kVAr)
1072	Reactive power Q, setpoint via system control
1073	Reactive power Q(P)
1074	cos φ, direct setpoint
1075	cos φ, setpoint via system control
1076	cos φ(P) characteristic curve
1077	Active power limitation P (W)
1078	Active power limitation P (%) of PMAX
1079	Active power limitation P via system control
1387	Reactive power Q, setpoint via analog input
1388	cos φ, setpoint via analog input
1389	Reactive power/voltage characteristic curve Q(U) with hysteresis and deadband
1390	Active power limitation P via analog input
1391	Active power limitation P via digital inputs
1392	Error
1393	Wait for PV voltage
1394	Wait for valid AC grid
1395	DC range
1396	AC grid
1455	Emergency switch
1466	Wait
1467	Start
1468	MPP search
1469	Shutdown
1470	Disturbance
1471	Warnning/error e-mail OK
1472	Warning/error e-mail not OK
1473	System info e-mail OK
1474	System info e-mail not OK
1475	Error e-mail OK
1476	Error e-mail not OK
1477	Warning e-mail OK
1478	Warning e-mail not OK
1479	Wait after grid interruption
1480	Wait for electric utility company

9 Contact

If you have technical problems concerning our products, contact the SMA Service Line. We require the following information in order to provide you with the necessary assistance:

- Modbus master software or hardware used
- Software version of your SMA Cluster Controller
- Type of communication interface between the SMA Cluster Controller and the inverters
- Type, serial numbers and software versions of the inverters connected to the PV plant

United States/ Estados Unidos	SMA America, LLC Rocklin, CA	+1 877-MY-SMATech (+1 877-697-6283)[2] +1 916 625-0870[3]
Canada/Canadá	SMA Canada, Inc. Toronto	+1 877-MY-SMATech (+1 877-697-6283)[4]

[2] toll free for USA, Canada and Puerto Rico / Exento de tasas en EE. UU., Canadá y Puerto Rico

[3] international / Internacional

[4] toll free for Canada / gratuit pour le Canada

10 Index

0

0x03 ... 15
0x04 ... 15
0x06 ... 15
0x10 ... 16
0x17 ... 16
0x8000 ... 17
0x8000 0000 ... 17
0xFFFF ... 17
0xFFFF FD ... 17
0xFFFF FFFF ... 17
0xFFFF FFFF FFFF FFFF ... 17

2

255
  Unit ID ... 20

3

30001 ... 27
30003 ... 27
30005 ... 27
30007 ... 27
30051 ... 27, 32
30055 ... 32
30057 ... 32
30059 ... 32
30197 ... 32
  Event numbers ... 55
  Event numbers ... 60
30199 ... 32
30201 ... 33
30203 ... 33
30205 ... 33
30207 ... 33
30211 ... 33
30213 ... 33
30215 ... 33
30217 ... 34
30219 ... 34
30225 ... 34
30227 ... 34
30229 ... 34
30231 ... 34
30233 ... 34
30247 ... 35
30249 ... 35
30251 ... 35
30257 ... 35
30513 ... 29, 35
30517 ... 29, 35
30521 ... 35
30525 ... 35
30529 ... 35
30531 ... 36
30533 ... 36
30535 ... 36
30537 ... 36
30539 ... 36
30541 ... 36
30543 ... 36
30545 ... 36
30547 ... 36
30549 ... 36
30559 ... 36
30561 ... 36
30565 ... 36
30567 ... 36
30569 ... 36
30571 ... 36
30573 ... 36
30575 ... 36
30577 ... 36
30579 ... 36
30581 ... 36
30583 ... 36
30585 ... 36
30587 ... 36
30589 ... 36
30591 ... 37
30593 ... 37
30595 ... 37
30597 ... 37
30599 ... 37
30769 ... 37
30771 ... 37

30773 37
30775 ..... 29, 37
30777 37
30779 37
30781 37
30783 37
30785 37
30787 37
30795 37
30797 37
30799 37
30801 37
30803 37
30805 37
30807 37
30809 37
30811 37
30813 38
30815 38
30817 38
30819 38
30821 38
30823 38
30825 38
30827 38
30829 38
30831 38
30833 38
30835 39
30837 39
30839 39
30843 39
30845 39
30847 39
30849 39
30851 39
30853 39
30855 39
30857 39
30859 39
30861 39
30863 39
30865 39
30867 39
30869 39
30871 40
30873 40
30875 40
30877 40
30879 40
30881 40
30883 40
30885 40
30887 41
30889 41
30891 41
30893 41
30895 41
30897 41
30899 41
30901 41
30903 41
30905 41
30907 41
30909 41
30911 41
30913 41
30915 41
30917 42
30919 42
30921 42
30923 42
31793 42
31919 42
31921 42
31983 42
31985 43
32047 43
32049 43
32051 43
34097 43
34101 43
34105 43
34109 43
34113 43
34121 43
34125 43
34127 43
34609 ..... 29, 43
34611 ..... 29, 43

34613 ..... 29, 43
34621 ..... 30, 43
34623 ..... 30, 43
34625 ..... 30, 43
34627 ..... 30, 43
34629 ..... 30, 43
34631 ..... 30, 43
34637 ..... 30, 44
34639 ..... 30, 44
34641 ..... 30, 44
34651 ..... 30, 44
34653 ..... 28, 44
34655 ..... 28, 44
35377 44
35381 44

4

40001 ..... 28, 31
40003 ..... 31, 45
40005 ..... 31, 45
40009 45
40013 45
40020 45
40039 46
40041 46
40043 46
40045 46
40047 46
40049 46
40051 46
40053 46
40055 46
40057 46
40059 46
40061 46
40071 47
40073 47
40075 47
40077 47
40079 47
40081 47
40083 47
40085 47
40087 47
40089 47
40091 47
40093 47
40095 47
40097 47
40099 47
40101 47
40103 47
40105 48
40107 48
40109 48
40111 48
40113 48
40115 48
40117 48
40119 48
40121 48
40123 48
40125 48
40127 48
40129 48
40131 49
40133 49
40135 49
40137 49
40141 49
40143 49
40145 49
40147 49
40149 49
40151 49
40153 49
40200 49
40202 50
40204 50
40206 50
40208 50
40210 50
40212 50
40214 50
40216 50
40218 50
40220 50
40222 50
40224 50
40226 51

40228 51
40230 51
40232 51
42109 ..... 14, 28
42110 28
42112 28
42113 28
42114 28
42116 28
43085 28
43086 28
43088 28

A

Activate
usrplant.xml 24
Addresss range
Modbus 15
ADR 26
Assignment tables 14
Header 26
Available and reserved unit IDs 14

B

Big-Endian 15

C

Change
Unit ID 20, 22
Change gateway 22
Changing device parameters
Flash memory 9, 31, 57
Not cyclical 9, 31, 57
CLCON-10 56
CLCON-S-10 56
Cluster Controller
Gateway 27
IP address 21
Signal run time 57
Common address of all SMA devices
Table 32
cos φ
Value range 32
Cyclical changing prohibited
Flash memory 9, 31, 57

D

Data
Presentation 18
Reduction 11
Data block 15
Associated registers 16
Number of Modbus registers 15
Writing multiple registers 16
Data format 18
Status values 17
Data processing 57
Data transfer
Capacity 57
Interval 57
Transfer break 57
Data types 17
Data volume
Register number 15
Deactivate
usrplant.xml 24
Default settings
Saving XML files 25
Delete
Unit IDs 25
Device parameters
Flash memory 9, 31, 57
Double assignment
Unit ID 22
DT 18
Duration 18
DWORD 17

E

ENUM 18, 60
Event numbers
Information on decrypting 55, 60
Extract
Firmware version 19

F

Fieldbus 8
Figure

SMA devices on Modbus data range . 11
Firmware version
Extract 19
FIX0 18
FIX1 18
FIX2 18
FIX3 19
Flash memory
Device parameters 9, 31, 57
Format
Table column 26
FW 19

G

Gateway 11, 14
Cluster Controller 27
GFDI 7

H

Hierarchical PV system structure 11

I

Identification
Time zones 58
Intended use 9
Internet 10
IP address
Cluster Controller 21

M

Modbus
Address range 15
Implementation 15
Parameter change 57
PDU 15
Ports 56
Reaction time of interface 57
Read Holding Registers 15
Read Input Registers 15
Read Write Multiple Registers 16
Register 15
Specification 15
TCP Port 56
UDP Port 56
Write Multiple Registers 16
Write Single Register 15
Modbus activation
Background information 20
Modbus address
Reassignment 52
Modbus assignments 14
Modbus data
Reading and writing 15
Modbus profile 11
SMA 11
User-defined 11, 52
Modbus registers
Data block 15
Motorola format 15

N

NaN
255 20
Overview 17
Network topology 11
Number code
Table columns 26
Number codes
ENUM 60
Time zones 58
Number of SMA devices 56

P

Parameter change
Reaction time 57
PDU
Modbus 15
PDU data
Number of Modbus registers 15
Quantity 15
Physical reaction time
Setpoint change 57
PMAX 7
Port
TCP 56
UDP 56
Power control and limitation 9, 31, 57
PV system parameters 14

Table 29
PV system structure
Hierarchical 11
PV system topology 11
SMA Cluster Controller 12

Q

Qualified Persons
Skills 9

R

RAW 19
Reaction time
of the Modbus interface 57
physical 57
Read Holding Registers 15
Read Input Registers 15
Read Write Multiple Registers 16
Readind and writing
Modbus data 15
Reading out the gateway 21
Reduktion
Available data 11
Register
Data block 15
Modbus 15

S

S16 17
S32 17
Safety 9
Serial number 21
Setpoint change
Physical reaction time 57
Signal run time
Cluster Controller 57
Skills
Qualified Persons 9
SMA Cluster Controller
PV system topology 12
SMA data formats 18
SMA data types 17
SMA devices 14
SMA fieldbus 8, 11
SMA inverters
Supported 56
SMA Modbus profile
Assignment tables 26
Explanation 11
Status values
Data format 17
Supported SMA inverters 56
SUSy-ID 8, 21
sysplant.xml 23
System stability 57

T

Table
Common address of all SMA devices ..32
PV system parameters 29
Target group 6
TEMP 19
Time behavior 57
Time zones 58
Identification 58
Number codes 58
Topology 11

U

U16 17
U32 17
U64 17
Unit ID
255 20
Architecture 14
Change 20, 22
Change via XML file 23
Delete 25
Double assignment 22
Incorrect data 22
Terminology 14
Unit ID = 1 ..... 14, 27
Unit ID = 2 ..... 14, 29
Unit ID = 3 bis 247 14
Unit IDs 14
Available and Reserved 14
User-defined Modbus profile 11
usrplant.xml 23

Activate 24
Deactivate 24
usrprofile.xml 52

V

Validity of this document 6
Value range
cos φ 32
virtual_modbusprofile 52

W

WORD 17
Write Multiple Registers 16
Write Single Register 15

X

XML
channel 52
destination 53
device 23
regoffs 23
serial 24
source 52
susyid 23
unitid 24, 52
virtual_modbusprofile 52
XML file
sysplant.xml 23
usrplant.xml 23
usrprofile 52
XML files
Default settings 25
Save 25

SMA Solar Technology

www.SMA-Solar.com

SMA America, LLC
www.SMA-America.com